A TARSIID PRIMATE AND A MIXODECTID FROM THE POWAY EOCENE, CALIFORNIA

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Communicated June 7, 1938

Introduction.—Following the discovery and description of a titanothere[1] in the Poway sands of San Diego County, continued excavation in this important Eocene horizon has produced small lots of mammalian remains. One of these included specimens of a tarsiid primate and a mixodectid. Worthy of mention is the fact that the former represents a third member of the Tarsiidae to be discovered in the early Tertiary of the Pacific Coast region. Since the Poway fauna possesses considerable significance in any attempt to correlate the later Eocene horizons of the Pacific Coast with those of the Cordilleran Province, it seems desirable to place on record these new mammals from the Poway.

Yumanius woodringi, n. gen. and n. sp.

Type Specimen.—Right maxillary fragment with $M\underline{1}$ and $M\underline{2}$, No. 2233, Calif. Inst. Tech. Vert. Pale. Coll., Plate 1, figure 1.

Paratypes.—Fragment of right ramus with $M\overline{1}$–$M\overline{3}$, No. 2234, Plate 1, figures 2, 2*a* and ramal fragment with $M\overline{2}$, $M\overline{3}$, No. 2235, Plate 1, figures 3, 3*a*.

Locality.—White sandstones associated with the Poway conglomerate and exposed on west bank of San Diego River, approximately one-quarter mile north and east of San Diego Mission; C. I. T. Vert. Pale., Loc. 249.

Generic and Specific Characters.—Upper molars differ from those of *Euryacodon lepidus* in possessing well developed and clearly defined hypocone or postero-internal cusp. Intermediate cusps also well developed. A second small cusp, comparable in size to that of the metaconule is situated between the latter and the base of the protocone. $M\underline{2}$ smaller than that in *Dyseolemur sylvestris* and hypocone, in contrast to that in the latter, more like a cingular cusp.

Lower molars 2 and 3 with trigonid portion of crown compressed anteroposteriorly and paraconid considerably reduced in size, more so than in *Euryacodon*. $M\overline{3}$ with broader posterior rim to heel. Distinctly different from *Dyseolemur* in reduction in size of trigonids in posterior molars and in absence of metastylid. I take pleasure in naming the species for my former colleague, Dr. Wendell P. Woodring of the U. S. Geological Survey.

Comparisons.—The upper molar teeth of *Yumanius woodringi* exhibit a cingulum on the outer, anterior and posterior sides of the crowns but the

basal ledge is lacking on the inner side. The small cuspule shown by Wortman[2] as situated at the inner base of the protocone in $M\underline{2}$ of *Euryacodon lepidus* is absent in the comparable tooth of *Y. woodringi*, but a slight development of the cingulum does occur in the second molar at the antero-internal base of the cusp. In the type specimen of *E. lepidus*, No. 11813 Y. P. M., the enamel of the crowns of the upper molars is smooth, the postero-internal cusp is not clearly indicated and the intermediate cuspules are small. In the molars of *Yumanius*, the postero-internal cusp shows pronounced development and the structural features of the crown become more complicated by the addition of a small cusp between metaconule and protocone. In addition the anterior ridge of the protocone, directed toward the protoconule, is more strongly formed in *Yumanius* than in *Euryacodon*.

The molars are unfortunately the only teeth preserved of the lower dentition. These resemble most closely the comparable teeth in *Euryacodon*. The enamel of the crowns is wrinkled, not smooth as in *Omomys;* the teeth are small, the paraconid while of normal size in $M\overline{1}$ becomes reduced to vestigial proportions or to the point of disappearance and the trigonid parts of the teeth are compressed anteroposteriorly. This compression of the trigonid portion of the crown is greater in the Poway genus than in *Euryacodon* or *Anaptomorphus*. In $M\overline{3}$ the posterior rim of the heel is broad and the end of the crown is not pointed as in *Euryacodon*. While no distinct metastylid is present as in *Dyseolemur* and *Washakius*, the posteriorly directed wing or ridge of the metaconid is extended in fore and aft line and is compressed transversely in *Yumanius*.

In the type of *Anaptomorphus aemulus* Cope, No. 5010 A. M. N. H., the teeth are smaller than in *Yumanius*. In $M\overline{1}$ of both forms the paraconid is well developed. This cusp becomes vestigial in $M\overline{2}$, but its reduction and the anteroposterior compression of the trigonid is greater in *Yumanius*. In the lower molars of the Bridger genus the external cingulum is not so well developed as in the San Diego specimens.

Discussion.—The upper and lower jaw specimens with teeth herein referred to the new genus *Yumanius* were found at one locality in the Poway but were not directly associated. The view that the type and paratypes belong to two distinct tarsiid genera cannot be ignored, although apparent absence of evidence other than that of fortuitous occurrence makes this possibility a seemingly remote one. Presence of this material in the Poway gives strength to the belief that Wortman's reference of the three lower jaw fragments of a tarsiid from the Bridger to *Euryacodon lepidus* is correct. It follows, as Matthew[3] pointed out, that *Anaptomorphus* and *Euryacodon* are probably identical. Among the several tarsiid genera recorded from the Bridger middle Eocene the Poway type is most closely related to the *Euryacodon-Anaptomorphus* stock. *Yumanius* appears to

have carried the line a stage farther and its presence at the San Diego locality suggests at least a post-Bridger age for the Poway. Curiously, *Y. woodringi* is more closely related to the Bridger species *E. lepidus* than to the Sespe type, *Dyseolemur pacificus*.

Microsyops kratos, n. sp.

Type Specimen.—A left ramus with $Dp\overline{3}$, $P\overline{4}$–$M\overline{3}$ inclusive and root fragments of the anterior premolars and canine, No. 2232, C. I. T. Vert. Pale. Coll., Plate 1, figures 4, 4*a*.

Locality.—Poway sandstones and conglomerates; C. I. T. Vert. Pale., Locality 249.

Specific Characters.—Differing from *Microsyops elegans* and *M. annectens* most noticeably in size. Smaller than *Craseops sylvestris*, but with lower molars, relative to size of jaw, larger than in latter species.

Description and Comparison.—This is the largest species of *Microsyops* so far recorded, being distinctly larger than *M. elegans* and *M. annectens* and resembling in size the species of *Craseops* recorded from the upper Eocene stage of the Sespe of Southern California. $Dp\overline{3}$ is a two-rooted tooth with simple crown. The latter is triangular in cross-section with apex placed forward. A downwardly directed ridge on the posterior surface of the principal cusp divides this surface into two parts. When the specimen was collected this tooth was loosely attached and on removal disclosed a small bit of enamel of a permanent tooth beneath. In front of $Dp\overline{3}$ is the exposed cross-section of the anterior premolar and presumably the canine. $P\overline{4}$ is the largest tooth of the series, $P\overline{4}$–$M\overline{3}$ inclusive. In this tooth only a vestige of the paraconid ridge remains and the metaconid does not reach the height of the protoconid. The basin of the talonid is deeply excavated. This tooth and the molars which follow all show a well defined cingulum at the base of the protoconid and below the notch between this cusp and the hypoconid. In $M\overline{3}$ the posterior wall of the hypoconulid is broken away. The ramus is sturdy and of approximately same depth

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PLATE 1

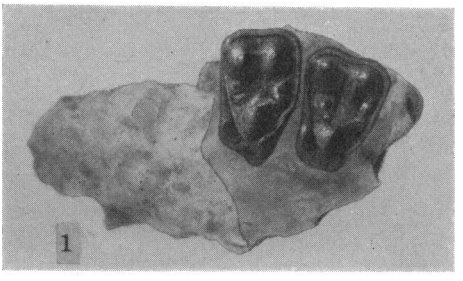
Yumanius woodringi, n. gen. and n. sp.

Figure 1, type specimen, No. 2233, skull fragment with $M\underline{2}$ and $M\underline{3}$, occlusal view. Figures 2, 2*a*, No. 2234, jaw fragment with $M\overline{1}$–$M\overline{3}$, view of inner side and occlusal view. Note: In figure 2*a*, the paraconid of $M\overline{1}$ has been restored. Figure 3, 3*a*, No. 2235, outer and occlusal views. All figures approximately ×6.

Microsyops kratos, n. sp.

Figures 4, 4*a*, type specimen, No. 2232, ramus with cheek teeth, lateral and occlusal views, ×2.

Calif. Inst. Tech. Vert. Pale. Coll. Poway Eocene, San Diego Co., Calif.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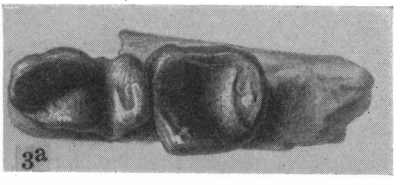
2a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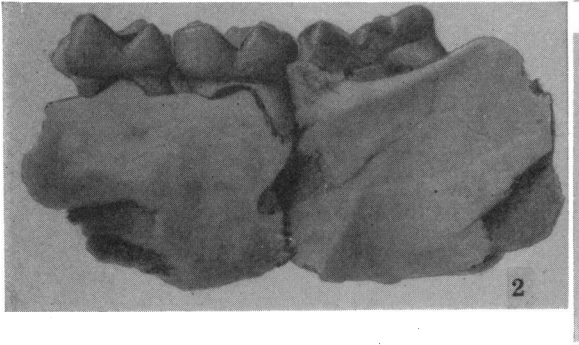
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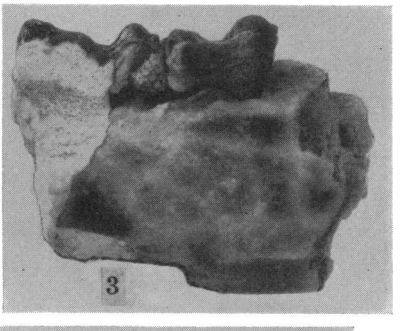
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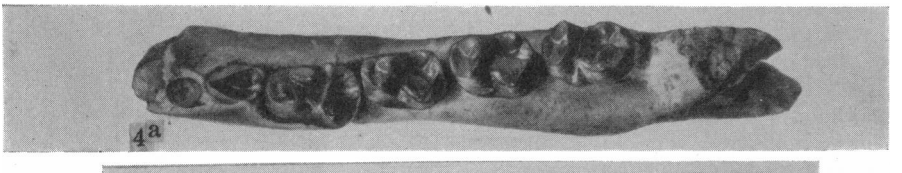
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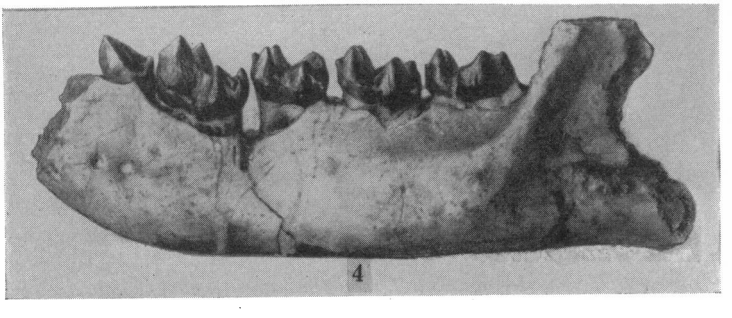
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throughout its length. Two mental foramina are situated below the anterior premolars.

Microsyops elegans from the Bridger, as represented by No. 12590, A. M. N. H., is a distinctly smaller, more slender form than the type from the Poway. In the former specimen the lower end of the symphyseal contact surface extends farther back than in No. 2232 from the Poway Eocene, and the second premolar is not crowded between adjacent teeth as in the latter. Moreover, there appears to be less discrepancy in length

COMPARATIVE MEASUREMENTS (IN MILLIMETERS)

	Microsyops kratos	*Microsyops elegans*	*Microsyops annectens*	*Craseops sylvestris*
	TYPE SPECIMEN		TYPE SPECIMEN	
	No. 2232 C. I. T.	No. 12590 A. M. N. H.	No. 11791 Y. P. M.	No. 1399 C. I. T.
Length from anterior end $Dp\bar{3}$ to posterior end of $M\bar{3}$	[a]28.7	....	....	....
Length from anterior end $P\bar{2}$ to posterior end of $M\bar{3}$	....	20.4	....	....
Length from anterior end $P\bar{3}$ to posterior end of $M\bar{3}$	....	18	....	....
Length from anterior end $P\bar{4}$ to posterior end of $M\bar{3}$	[a]24.8	15	....	....
$Dp\bar{3}$, length	3.9	....	....	....
$Dp\bar{3}$, width	2.4	....	....	....
$P\bar{4}$, length	6.6	3.6	....	....
$P\bar{4}$, width	4.2	2.6	....	....
$M\bar{1}$, length	5.5	3.5	....	....
$M\bar{1}$, width	4	2.4	....	....
$M\bar{2}$, length	6	....	....	6.3
$M\bar{2}$, width	4.2	3	....	4.6
$M\bar{3}$, length	[a]6.2	4.5	5.7	7.1
$M\bar{3}$, width	3.9	3	3.5	4.5
Depth of ramus at posterior end of $M\bar{3}$	11.5	9	11.4	15
Depth of ramus at anterior end of $M\bar{2}$	10.9	8.2	....	14.2
Thickness of ramus below $M\bar{2}$	6.1	4.2	....	6.9
Thickness of ramus below $M\bar{3}$	6.2	....	4.5	8

[a] Approximate

between $P\bar{4}$ and $M\bar{1}$ in the Bridger species than in that from the San Diego locality.

No. 12050 A. M. N. H., also from the Bridger Eocene and determined as *Microsyops annectens*, approaches the Poway specimen in size. While the ramus exhibits a depth like that in the Californian type, its thickness is distinctly less.

No. 1399 C. I. T., representing *Craseops sylvestris* from the Sespe possesses a more massive ramus with the upper anterior border and the anterior end of the masseteric area decidedly more pronounced than in *Microsyops*

kratos. The two molar teeth preserved in No. 1399, $M\bar{2}$ and $M\bar{3}$, are slightly broader in comparison to their length in *Craseops* than in *Microsyops* from the Poway.

[1] Stock, C., *Proc. Nat. Acad. Sci.*, **23**, 48–53 (1937).
[2] Wortman, J. L., *Amer. Jour. Sci.*, Ser. 4, **17**, 139–140, fig. 133 (1904).
[3] Matthew, W. D., and Granger, W., *Bull. Amer. Mus. Nat. Hist.*, **34**, 457 (1915).

LARGEST DEGREE OF A SUBSTITUTION IN THE GROUPS OF A GIVEN DEGREE

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Communicated May 28, 1938

Let G represent a substitution group of degree n and let s represent a substitution of G which has the property that none of the substitutions of G has a degree which exceeds that of s. It follows directly from the average number of letters in the substitutions of a given group that the degree of s cannot be less than $n/2 + 1$. It has recently been proved[1] that when the degree of s has this smallest possible value, then all the substitutions of G besides the identity are of the same degree and G is an abelian group whose order is a power of 2. Moreover, n must then be of the form $2^m + 2^{m-1} + \ldots + 2$ and there is one and only one such group for an arbitrary positive integral value of m. The order of this group is 2^m and it is conformal with the abelian group of type 1^m. Every substitution besides the identity of an arbitrary one of this infinite system of groups has exactly half of its letters in common with every other substitution besides the identity of this group whenever $m > 2$.

When the degree of s exceeds $n/2 + 1$ it is at least as large as $n/2 + 3/2$, and when it has this value there are only three possible groups, viz., the two groups of degree 3 and the nonabelian group of degree 5 and of order 6 whose transitive constituents are of degrees 2 and 3, respectively. As this fact was also established in the article to which we referred above, the smallest possible relative degree of s which has not been considered is $n/2 + 2$. When the degree of s is $n/2 + 1$ the group of degree 2 is the only possible transitive group, and when it is $n/2 + 3/2$ the two groups of degree 3 are the only possible transitive groups. It is obvious that when the degree of s is $n/2 + 2$ then the five transitive groups of degree 4 are the only possible transitive groups but there are then two intransitive groups in addition to three infinite systems of such groups whose degrees are of the